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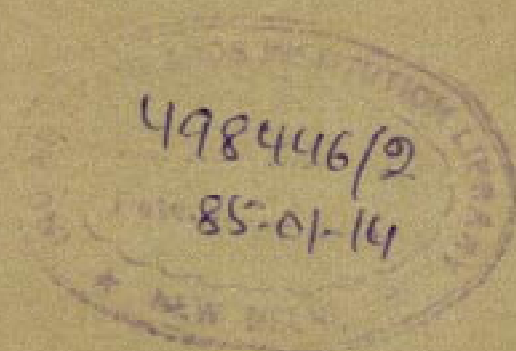
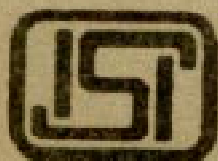
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Indian Standard

EVALUATION PROCEDURE FOR Y-GROOVE WELD CRACKABILITY TEST IN STRUCTURAL STEEL

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

EVALUATION PROCEDURE FOR Y-GROOVE WELD CRACKABILITY TEST IN STRUCTURAL STEEL

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Indian Standard

EVALUATION PROCEDURE FOR Y-GROOVE WELD CRACKABILITY TEST IN STRUCTURAL STEEL

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 11 April 1984, after the draft finalized by the Welding General Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 A special panel for weldability study of structural steels, SMDC/SP1, set up by the Structural and Metals Division Council of ISI, had recommended a draft specification for weldable structural steel. Wrought Steel Products Sectional Committee, SMDC 5, responsible for the preparation of standards on structural steel has agreed in principle with the draft recommended by the special panel with certain modifications and has processed it as IS : 2062-1984*.

0.3 While recommending the draft the panel felt that the cold-cracking tendency of the steel cannot be judged purely from the chemical composition or carbon equivalent and actual tests should be conducted to study this aspect of weldability. Since no single universally accepted test is available to characterise cold cracking, the panel tentatively recommended that a test procedure for Y-groove weld crackability test based on the Japanese Standard JIS Z 3158-1966 'Diagonal Y-type weld crack testing methods' shall be formulated.

Accordingly this standard is prepared giving the evaluation procedure for Y-groove weld crackability test in carbon and low alloy structural steels.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Specification for weldable structural steel (*third revision*).

†Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies the evaluation procedure for Y-groove weld crackability test for carbon and low alloy structural steels and is applicable for the following products:

- a) Plates of thickness over 12 mm;
- b) Flats of over 12 mm thickness and 80 mm width;
- c) Beams having a minimum thickness of flange as 12.5 mm and minimum width of flange as 165 mm;
- d) Channels having a minimum thickness of leg of 12.5 mm and a minimum width of flange as 165 mm;
- e) Angles having a minimum thickness of leg of 12.5 mm and a minimum width of 80 mm of at least one of the legs; and
- f) Tee-bars having a minimum thickness of flange of 12.5 mm and minimum width of flange of 165 mm.

2. SELECTION AND LOCATION OF TEST MATERIAL

2.1 Subject to the scope of this procedure, this test shall be carried out on the product of maximum thickness that is rolled from a cast of the material. The location and extraction of the test material shall be as given in 2.2 to 2.4.

2.2 The test materials from plates and flats shall be extracted from the product as shown in Fig. 1.

2.3 In the case of beams, channels, angles and tee-bar sections, the test materials shall be extracted from the region of higher thickness as illustrated in Fig. 2.

2.4 The test materials shall be extracted from the products in such a manner that the length of the test material is parallel to the direction of rolling of the product (see Fig. 1 and 2).

3. PREPARATION OF THE TEST MATERIAL

3.1 The test materials shall be prepared to the dimensions shown in Fig. 3 A.

3.2 The opening edges shall be normally prepared by machining and shall have surface roughness N9 to N7 assessed in accordance with IS : 3073-1967*.

*Assessment of surface roughness.

4. TEST PROCEDURE

4.1 The two portions of the test material shall be assembled with a spacer of a little over 2 mm as shown in the section *AA* of Fig. 3B. For strength and stability, both sides of the test material may be given temporary welding.

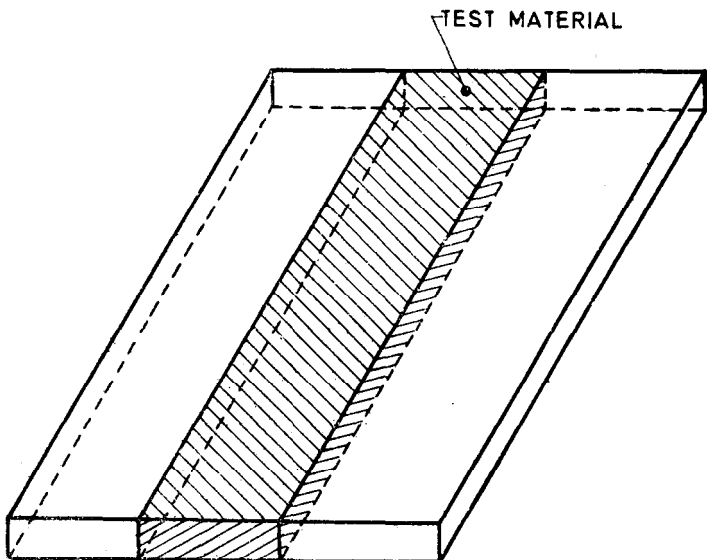


FIG. 1 TEST MATERIAL EXTRACTION FROM PLATES AND FLATS

4.2 The 'X' portions of the test assembly as shown in Fig. 3 B shall be welded first. A low hydrogen electrode of 4 mm or 5 mm diameter shall be used, welding being started with one layer on the back surface. The weld shall be completed by giving alternate layers on the front and back grooves taking precautions to avoid angular and square deformations. Automatic or semiautomatic processes such as gas metal arc welding or submerged arc welding may also be used for welding the 'X' portions of the test assembly.

4.3 After the completion of the 'X' welds on both sides of the Y-groove, the test assembly shall be allowed to cool to the ambient temperature.

4.4 All water droplets and oily substances in the test weld region shall be completely removed by means of a burner and after ensuring sufficient cooling of the test assembly after this operation, the slit shall be further cleaned by wire brush or abrasive paper followed by acetone cleaning.

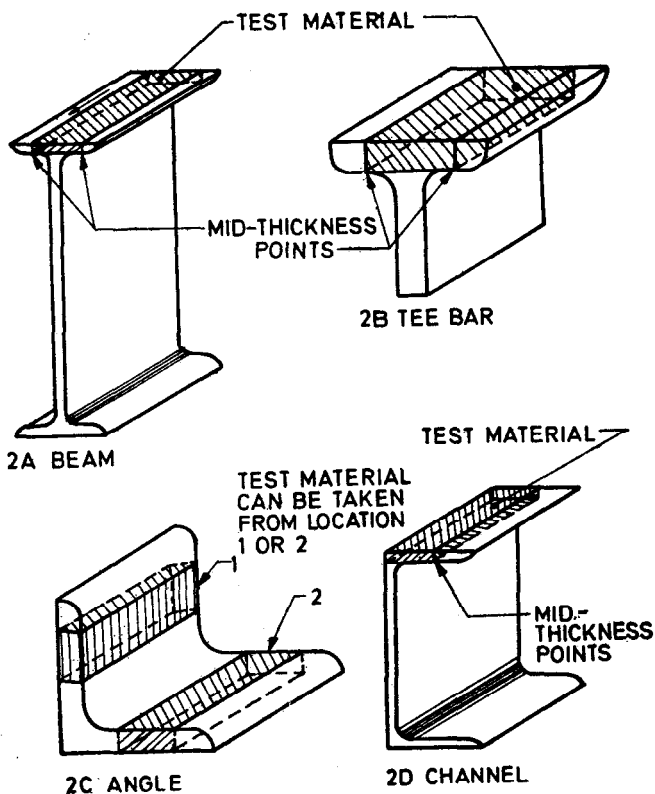


FIG. 2 TEST MATERIAL EXTRACTION FROM SECTIONS

4.5 The test weld shall be laid using a suitable rutile electrode of type E3 XXXXX conforming to IS : 814 (Part 1)-1974*, the mechanical properties of the weld metal being so chosen as to match the type of steel. Prior to use the electrode should be baked at a temperature of 100°C for 1 hour or as recommended by the manufacturer.

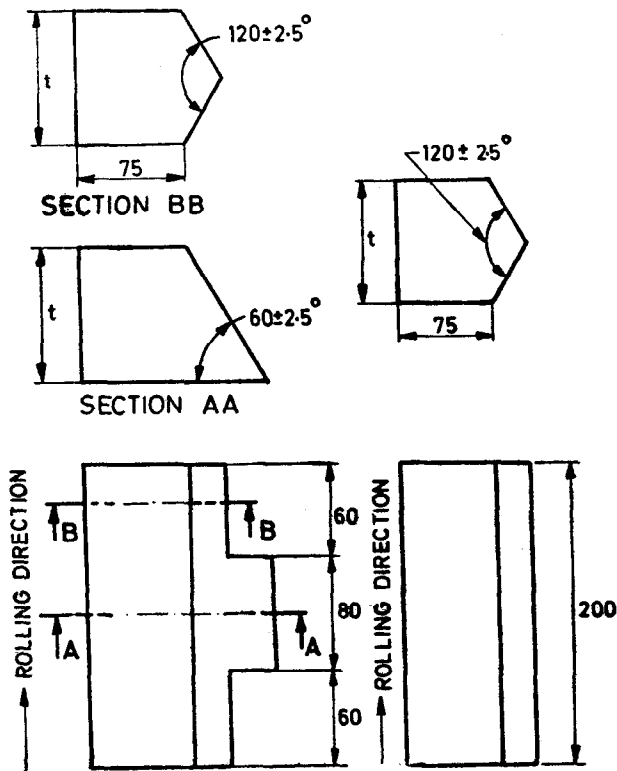
4.6 In the test weld portion, spacers of little more than 2 mm are inserted adjacent to 'X' welds as shown in Fig. 5 and for strength and stability they may be given temporary welding.

*Specification for covered electrodes for metal arc welding of structural steel: Part 1 For welding products other than sheets (fourth revision).

The test weld shall be laid into the Y-groove as a single bead using an electrode of 4 mm diameter. Care shall be taken so that the start of the bead and the crater end do not occur in the slit region as illustrated in Fig. 4.

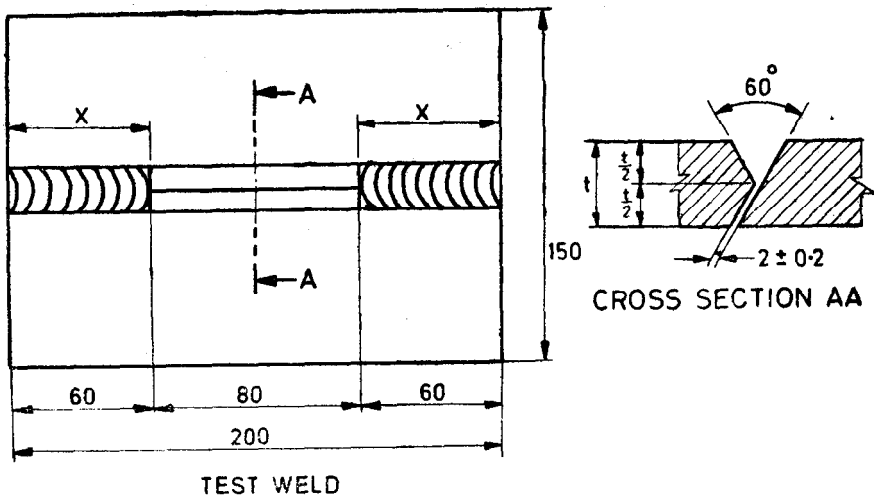
4.7 The test weld shall be deposited only in the downhand or flat position at the ambient temperature or at $27 \pm 2^\circ\text{C}$.

4.8 The welding parameters for the test weld shall be strictly in accordance with the recommendations of the electrode manufacturer. The welding parameters may be recorded.



t = thickness of material
 (For sections t is the flange thickness)
 3A Test Material After Machining
 All dimensions in millimetres.

FIG. 3 TEST ASSEMBLY—Contd



3B Test Material After Assembly
All dimensions in millimetres.

FIG. 3 TEST ASSEMBLY

4.9 After the completion of the test weld, the test assembly shall be allowed to cool and remain undisturbed for a period of 48 hours after the completion of welding.

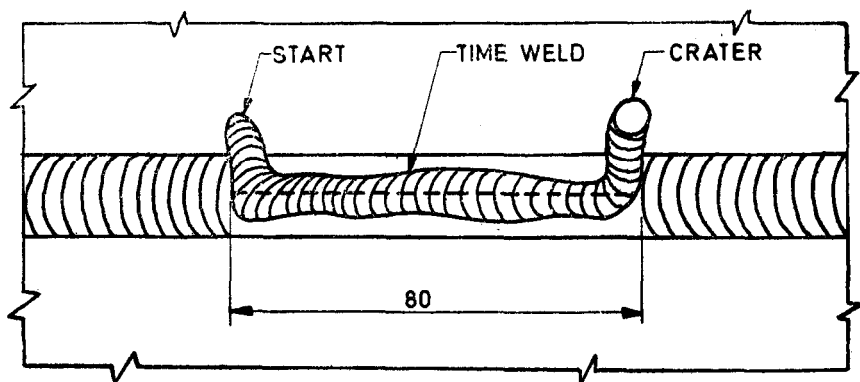
5. EVALUATION OF THE TEST WELD

5.1 After the elapse of 48 hours in accordance with 4.9 above, magnetic particle inspection shall be carried out in the test weld region for the detection of surface and sub-surface cracks.

5.2 If no cracks are detected after the magnetic particle inspection, the test weld shall be cut into five sections as shown in Fig. 5. This cutting shall be carried out only by mechanical means and adequate care shall be taken to avoid too much of vibration so that any existing cracks do not extend due to the cutting operation.

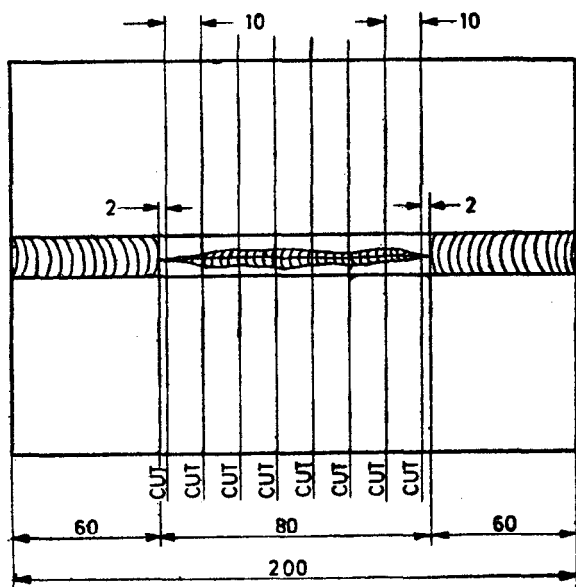
5.3 One side each of the above five sections shall be ground, polished and etched. For etching a solution consisting of 3 ml sulphuric acid and 3 g picric acid in 100 ml of methyl or ethyl alcohol or 5 percent nitric acid in methyl or ethyl alcohol or water may be used.

5.4 The five specimens shall be examined at a magnification of 20 to 50 × and presence of cracks, if any, in the root region of the test weld shall be noted.



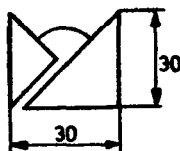
All dimensions in millimetres.

FIG. 4 TEST ASSEMBLY SHOWING THE TEST WELD



All dimensions in millimetres.

FIG. 5 CUTTING OF SPECIMENS FOR DETECTION OF CRACKS IN THE TEST WELD



SPECIMEN SIZE FOR INSPECTION OF CRACK

6. ACCEPTANCE CRITERIA

6.1 The test specified in this procedure shall be carried out on the product of maximum section thickness that has been rolled out of the given cast of the steel. The entire cast shall be deemed to be 'weldable' if no crack is observed in the heat affected zone or fusion line after the evaluation procedure outlined in 5. If this material reveals cracks, all products of the thickness selected shall be deemed not have met the requirements of the standard.

6.2 The entire procedure shall be repeated on the product of the next lower thickness produced from the same cast. If this thickness of the product produces crack free welds in this test, all the products of the cast of this lower thickness and others having thickness lower than this particular thickness shall be deemed to have met the requirements of the standard.

6.3 If the lower thickness of the product described in 6.2 also does not produce crack free welds in this test, the procedure in 6.2 shall be repeated on the next lower thickness and so on. The aim of this provision is to help utilise as much steel produced from a given cast.

7. SUPPLEMENTARY PROVISIONS

7.1 These provisions have been added to help utilise as much steel produced in a given cast as possible and to reduce the wastage of the steel.

7.2 If in a given cast, the product of the maximum thickness reveals cracking during the evaluation procedure carried out in accordance with 5, the entire test procedure from 2 to 5 shall be repeated except that for the test weld (4.5 to 4.8), a suitable basic coated low hydrogen electrode shall be used. These electrodes shall be baked at a temperature of 350°C for one hour and maintained at 80°C till used. If the baking and drying conditions recommended by the electrode manufacturer are different from this, the manufacturer's recommendations shall prevail.

7.3 If this revised test produces a crack-free weld after evaluation in accordance with 5, products of this thickness and the other thicknesses which did not meet the requirements of the original provisions shall be accepted but with a special remark in the test certificate as:

'WELDABLE ONLY WITH LOW HYDROGEN ELECTRODES'

7.4 If the test weld after the revised testing as in 7.2 also reveals cracks, this particular thickness of the products from the cast shall be deemed not to have met the supplementary requirement also. The entire procedure shall then be repeated on the product of the next lower thickness

of the same cast which also did not meet the requirements of the original provisions. If this lower thickness product produces crack free welds, this lower thickness product as well as other products of still lower thickness which did not meet the original provisions shall be accepted with the special remark on the test certificate as outlined in 7.3. If cracking is observed on the second lower thickness also, this thickness of the products shall also be deemed not to have met the supplementary requirements also and the test procedure shall be repeated on the third lower thickness and so on.

7.5 The products of those thicknesses which did not qualify even after the supplementary tests shall be accepted only with the following special remark in the test certificate:

DIFFICULT TO WELD WELDING PROCEDURE SHOULD BE ESTABLISHED BEFORE WELDING THE ACTUAL PRODUCTS

(Continued from page 2)

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